INDOOR AIR QUALITY ASSESSMENT

New Shrewsbury High School
Cypress Avenue
Shrewsbury, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of the Nancy Allen, Director of the Shrewsbury Health Department, the Bureau of Environmental Health Assessment (BEHA) of the Massachusetts Department of Public Health (MDPH) was asked to provide assistance and consultation regarding water penetration into the interior of several areas within the new Shrewsbury High School (SHS) that is under construction.

On April 18, 2002, a visit was made to this school by Michael Feeney, Director of the Emergency Response/Indoor Air Quality (ER/IAQ) program, BEHA, to conduct an indoor air quality assessment. Mr. Feeney was accompanied by Ms. Allen and Robert Moore of the Shrewsbury Health Department. This request was prompted by reports of water damage to interior walls constructed from gypsum wallboard (GW) in several areas within the building.

The new SHS is a three-story multi-wing structure. Two atriums exist at the front and the rear of the building. The ventilation system was not activated at the time of the assessment.

The building has been previously evaluated by several consultants for biological and moisture contamination. On November 30, 2001, the building was evaluated by International Engineering Group, LLC (IEG). IEG made the following recommendations for rooms E118, D229, D306, F307 and F319:

1. Remove the lower 4 feet of gypsum wallboard (GW);
2. Remove fiberglass within walls;
3. Disinfect studs and U-channel of walls;
4. Install new insulation batting and GW; and
5. Remediate water infiltration (IEG, 2001).

A second consultant, R. W. Granger & Sons, Inc. (RWGS), conducted an evaluation in the building. RWGS made the following recommendations for areas F307, F315, F319, E118, D306 and D307:

1. Remediation of contaminated materials (GW, insulation)
2. Decontamination of materials left in place (plywood, steel studs and wall block);
3. Remediation of water infiltration and
4. Clearance testing after remediation was complete (RWGS, 2002).

Microbial sampling was recommended for areas E215, D230, D234, D201, D317, the gymnasium, auditorium, A008, C148, C176 and B103 (RWGS, 2002).

Methods

Visual observation of GW for mold was conducted. Water content of GW was measured with Delmhorst, BD-2000 Model, Moisture Detector with a Delmhorst Standard Probe. Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. Test results are shown in Table 1.

Results/Discussion

The building was evaluated on a warm day, with an outdoor temperature of 80^{o}F and relative humidity of 41 percent. No active leaks were observed and no visible, accumulated moisture was noted on ceilings, walls or the cement floor during the assessment. Relative humidity indoors was measured in a range of 42 to 47 percent, which was 1-6 percent higher than outdoor concentrations. The application of various cement compounds on floors may account for the elevated water concentration.

Moisture measurements were taken in GW of various areas with a documented history of water damage. In many areas GW did not have measurable moisture levels, however a total of 7 areas tested had moisture concentrations ranging from 0.1 to 0.4 percent. These moisture concentrations were found in both GW along exterior walls, as well as GW making up interior dividing walls. Bare GW within the D235 section (see Picture 1) had a black material growing near the floor. This mold growth indicates that GW was saturated with water, resulting in the colonization of mold.

BEHA personnel have consulted with Dr. Harriet Burge, Chairperson of the Microbiology Department at the Harvard School of Public Health concerning mold contaminated GW in previous investigations. According to Dr. Burge, the reoccurrence of mold growth after the application of bleach is common. Bleach consists of sodium hypochlorite in a 5 percent concentration mixed with water. Mold colonization of GW can penetrate through its entire structure. When applied to moldy GW, the water of the bleach solution penetrates into the moldy GW, but the sodium hypochlorite remains on the surface of the GW. The sodium hypochlorite disinfects the surface mold that it comes in contact with on the GW surface, but not the mold beneath the surface. The additional water added to the subsurface mold fuels a spurt in growth, which increases mold colonization of the GW. As a result, mold colonies appear on the surface of treated GW shortly after application of bleach (Burge, 1999).

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Mold colonized GW cannot be adequately cleaned to remove mold growth.

Several areas of the exterior wall system remain unfinished (see Pictures 2 through 6). These open breaches in the exterior wall system can be a source of water infiltration into the building during driving rain. Sealing the exterior wall system will serve to prevent further damage to interior walls.

Several passive fresh air intakes exist of the roof with openings facing south (see Picture 7). Each of these vents are connected to unit ventilators for third floor classrooms. The location of the duct openings may make these vents prone to water penetration during rainstorms with a southwest wind. Water penetration into these vents may result in water accumulation in the base of ducts and lead to subsequent microbial growth within univents.

Conclusions/Recommendations

In view of the findings at the time of the inspection, the following recommendations are made:

1. Previous recommendations of IEG and RWGS should be implemented.
2. All GW that show visible microbial growth should be replaced.
3. Consideration should be given to re-positioning the duct shown in Picture 7 to face north. One possible solution would be to install a revolving head roof ventilator to direct the duct opening opposite to the prevailing wind. Consideration should be given to inject fresh air into the duct to aid the univent's draw of outdoor air.

References

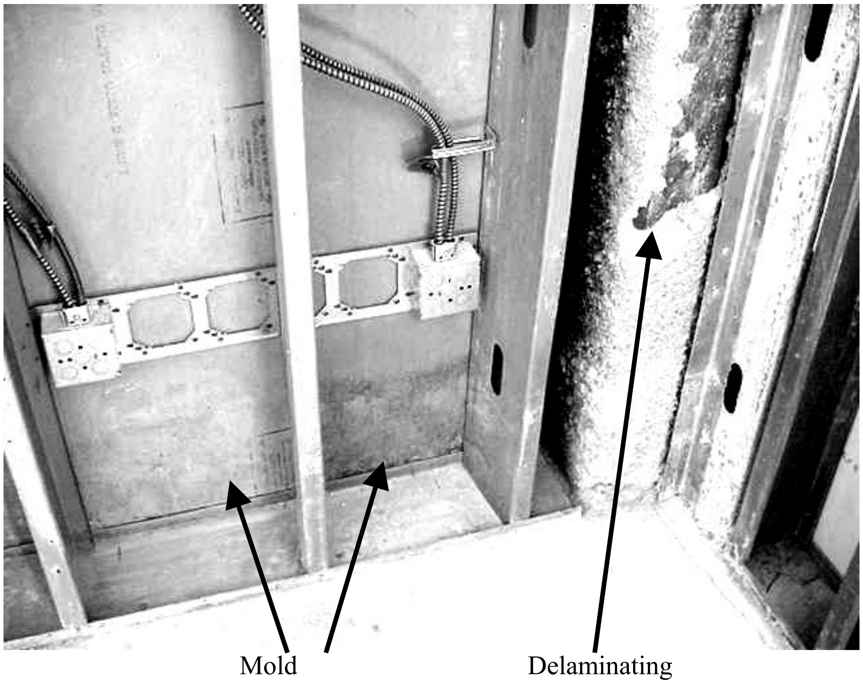
ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

Burge. 1999. Personal Conversation with Dr. Harriet Burge, Harvard School of Public Health. December 13th, 1999.

IEG. 2001. Report on Shrewsbury High School. International Engineering Group, LLC. November 30, 2001.

RWGS. 2002. Indoor Air Quality Sampling Report for Shrewsbury High School. Prepared by Martha Catevenis, Granger Safety and Industrial Hygiene Services. Portland, ME. January 21, 2002.

Picture 1



Mold Contaminated Wallboard,
Note Delaminating of Fireproofing on Beam

Picture 2

Exterior of Front of Building near Lobby, Note Lack of Exterior Panels

Picture 3

Rear Atrium in Courtyard on Back of Building, Note Lack of Exterior Panels and Peeled Felt

Picture 4

Rear Atrium in Courtyard on Back of Building, Note Lack of Exterior Panels and Peeled Felt

Picture 5

Close-up of Exposed Seam in Picture 4,

Picture 6

Exterior of Front of Building near Lobby, Note Lack of Exterior Panels

Picture 7

Passive Fresh Air Intake on Roof Facing South-South West

TABLE 1

Moisture Sampling Results –New Shrewsbury High School, Shrewsbury, MA **April 18, 2002**

Location	Carbon Dioxide *ppm	Temp °F	Relative Humidity %	Moisture Sample Taken In Gw On Exterior Wall %	Moisture Sample Taken In Gw On Hallway Wall %	Moisture Sample Taken In Gw On Classroom Dividing Wall %	Remarks
F307	567	79	47	ND	0.3	ND	
F319	529	79	45	ND	ND	ND	
F317	521	78	45	ND	0.2	ND	Wood moisture content = 11.7%
D314	461	79	44	ND	ND	ND	
D311	467	79	43	ND	ND	0.1	Wood moisture content = 14.6%
D324	507	80	46	ND	ND	ND	
D321	542	80	44	ND	ND	ND	
E315	477	79	44	ND	ND	ND	
Media Center	492	78	42	ND	ND	0.4	
D235	488	78	43	ND	0.4	0.4	visible mold growth on GW; delaminating fireproofing
Outdoor	417	80	41				

*** ppm = parts per million parts of air**
ND = Non Detectable Concentration of Moisture